CLAIM AMENDMENTS

Please amend the claims as follows:

21. (currently amended) An optical identification element having a synthesized chemical attached thereto, comprising:

an optical substrate having at least one diffraction grating disposed therein, said grating having a resultant refractive variation at a grating location, said grating being embedded within a substantially single material of said optical substrate;

said grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating in free space, said code identifying at least one of the element and said chemical, said output signal being a result of passive, non-resonsant scattering from said grating when illuminated by said incident light signal; and

the synthesized chemical being attached to said substrate.

22. (previously presented) The apparatus of claim 21 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

23. (previously presented) The apparatus of claim 21 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

24. (previously presented) The apparatus of claim 21 wherein said substrate is made of a material selected from the group: glass, silica, plastic, rubber, and polymer.

25. (previously presented) The apparatus of claim 21 wherein said code comprises a plurality of digital bits.

26. (previously presented) The apparatus of claim 21 wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 28, 30, 40, 50, or 100.

27. (previously presented) The apparatus of claim 21 wherein said code comprises a plurality of bits, each bit having a plurality of states.

28. (previously presented) The apparatus of claim 21 wherein said code comprises a plurality of bits, each bit having a corresponding spatial location and each bit in said code having a value related to the intensity of said output optical signal at the spatial location of each bit.

29. (previously presented) The apparatus of claim 28 wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

30. (previously presented) The apparatus of claim 21 wherein said code comprises a plurality of digital bits, each bit having a corresponding spatial location and each bit in said code having a binary value related to the intensity of said output optical signal at the spatial location of each bit.

31. (previously presented) The apparatus of claim 30 wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

32. (previously presented) The apparatus of claim 21 wherein said incident light comprises a single wavelength.

33. (previously presented) The apparatus of claim 21 wherein said substrate has a coating disposed on at least a portion of said substrate, at least a portion of said coating being made of a material that allows sufficient amount of said incident light signal to pass through said material to allow detection of said code.

34. (previously presented) The apparatus of claim 21 wherein said substrate has a coating material disposed on at least a portion of said substrate, said coating comprising a polymer.

35. (previously presented) The apparatus of claim 21 wherein at least a portion of said substrate has a 3-D shape selected from the group: a cylinder, a sphere, a cube, and a pyramid.

36. (previously presented) The apparatus of claim 21 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said substrate has a plurality of grating regions.

37. (previously presented) The apparatus of claim 21 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is greater than that of said non-grating region.

38. (previously presented) The apparatus of claim 21 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is not greater than that of said non-grating region.

39. (previously presented) The apparatus of claim 21 wherein said incident light is incident on said substrate along a longitudinal grating axis of said grating.

40. (previously presented) The apparatus of claim 21 wherein said incident light is incident on said substrate at an angle to a longitudinal grating axis of said grating.

41. (previously presented) The apparatus of claim 21 wherein said grating comprises a thin grating or a blazed grating.

42. (previously presented) The apparatus of claim 21 wherein said substrate comprises a plurality of said gratings.

43. (previously presented) The apparatus of claim 21 wherein said substrate comprises a plurality of said gratings each at different locations within said substrate.

44. (previously presented) The apparatus of claim 21 wherein said substrate comprises a particle or bead.

45. (previously presented) The apparatus of claim 21 wherein said chemical comprises at least one gene, nucleotide, protein, antibody, antigen, peptide, amino acid, NDA, cDNA, RNA, nucleic acid, polymer, cell, hydrocarbon, atom, or portion thereof.

46. (previously presented) The apparatus of claim 21 wherein said chemical is synthesized using a split-and-pool technique.

47. (current amended) A method of synthesizing a chemical on a substrate, comprising:

obtaining at least one substrate, each having at least one diffraction grating disposed therein, said grating having a resultant refractive variation at a grating location, said grating being embedded within a substantially single material of said substrate, and providing an output optical signal indicative of a code when illuminated by an incident light signal propagating in free space, said code identifying at least one of the element and said chemical, said output signal being a result of passive, non-resonsant scattering from said grating when illuminated by said incident light signal; and

synthesizing the chemical on said substrate.

48. (previously presented) The method of claim 47 comprising a plurality of said substrates.

49. (previously presented) The method of claim 47 wherein said synthesizing is performed using a split-and-pool technique.

50. (previously presented) The method of claim 47 wherein said chemical has predetermined chemical components and comprising attaching predetermined ones of said components to corresponding predetermined ones of said substrates in a predetermined order.

51. (previously presented) The method of claim 50 comprising combining said substrates together in a common container after each of said components are attached to said substrates.

52. (previously presented) The method of claim 50 comprising sorting said substrates by said code after each of said components are attached to said substrates.

53. (previously presented) The method of claim 50 wherein said chemical comprises a nucleic acid and said components at least include bases: G, C, A and T.

54. (previously presented) The method of claim 47 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

55. (previously presented) The method of claim 47 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

56. (previously presented) The method of claim 47 wherein said substrate is made of a material selected from the group: glass, silica, plastic, rubber, and polymer.

57. (previously presented) The method of claim 47 wherein said code comprises a plurality of digital bits.

58. (previously presented) The method of claim 47 wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 28, 30, 40, 50, or 100.

59. (previously presented) The method of claim 47 wherein said code comprises a plurality of bits, each bit having a plurality of states.

60. (previously presented) The method of claim 47 wherein said code comprises a plurality of bits, each bit having a corresponding spatial location and each bit in said code having a value related to the intensity of said output optical signal at the spatial location of each bit.

61. (previously presented) The method of claim 60 wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

62. (previously presented) The method of claim 47 wherein said code comprises a plurality of digital bits, each bit having a corresponding spatial location and each bit in said code having a binary value related to the intensity of said output optical signal at the spatial location of each bit.

63. (previously presented) The method of claim 62 wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

64. (previously presented) The method of claim 47 wherein said incident light comprises a single wavelength.

65. (previously presented) The method of claim 47 wherein said substrate has a coating disposed on at least a portion of said substrate, at least a portion of said coating being made of a material that allows sufficient amount of said incident light signal to pass through said material to allow detection of said code.

66. (previously presented) The method of claim 47 wherein said substrate has a coating material disposed on at least a portion of said substrate, said coating comprising a polymer.

67. (previously presented) The method of claim 47 wherein at least a portion of said substrate has a 3-D shape selected from the group: a cylinder, a sphere, a cube, and a pyramid.

68. (previously presented) The method of claim 47 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said substrate has a plurality of grating regions.

69. (previously presented) The method of claim 47 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is greater than that of said non-grating region.

70. (previously presented) The method of claim 47 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is not greater than that of said non-grating region.

71. (previously presented) The method of claim 47 wherein said incident light is incident on said substrate along a longitudinal grating axis of said grating.

72. (previously presented) The method of claim 47 wherein said incident light is incident on said substrate at an angle to a longitudinal grating axis of said grating.

73. (previously presented) The method of claim 47 wherein said grating comprises a thin grating or a blazed grating.

74. (previously presented) The method of claim 47 wherein said substrate comprises a plurality of said gratings.

75. (previously presented) The method of claim 47 wherein said substrate comprises a plurality of said gratings each at different locations within said substrate.

76. (previously presented) The method of claim 47 wherein said substrate comprises a particle or bead.

77. (previously presented) The method of claim 47 wherein said chemical comprises at least one gene, nucleotide, protein, antibody, antigen, peptide, amino acid, NDA, cDNA, RNA, nucleic acid, polymer, cell, hydrocarbon, atom, or portion thereof.